Advanced International Seminar

Advances on Intelligence Research: What should we expect from the XXI Century

Facultad de Psicología
Universidad Complutense de Madrid

7-8th April 2016

Thursday, 7th April

The Measurement of Intelligence in the XXI Century: Could be Video Games an Alternative?

M. Ángeles Quiroga
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Abstract

Here I wonder if there are new procedures for measuring intelligence. First, some important features for the measurement of intelligence are highlighted: a) Intelligence tests tap the second-stratum level from the CHC model, namely, Gf, Gc, Gy, Gv, Gu, Gr, Gs, Gt- and the best estimates of the *g* factor are Gf tests; b) more than one test is required for properly capturing the latent factor of interest and for controlling for the specific variance –format variance-; c) IQ is a score that can be obtained from any test, but IQ is not a test. Second, studies analyzing the potential use of video games as intelligence measures will be reviewed, using the Ackerman's model relating individual differences and skill learning as the theoretical framework. Third, features of different video games genres will be checked as potential measures of intelligence. Essential characteristics of good tests based on video games will be proposed.

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Education and Intelligence: Pity the Poor Teacher because Student Characteristics are more Significant than Teachers or Schools.

Douglas K. Detterman
Case Western Reserve University

Abstract

Education has not changed from the beginning of recorded history. The problem is that focus has been on schools and teachers and not students. Here is a simple thought experiment with two conditions: 1) 50 teachers are assigned by their teaching quality to randomly composed classes of 20 students, 2) 50 classes of 20 each are composed by selecting the most able students to fill each class in order and teachers are assigned randomly to classes. In condition 1, teaching ability of each teacher and in condition 2, mean ability level of students in each class is correlated with average gain over the course of instruction. Educational gain will be best predicted by student abilities (up to $r = 0.95$) and much less by teachers' skill (up to $r = 0.32$). I argue that seemingly immutable education will not change until we fully understand students and particularly human intelligence. Over the last 50 years in developed countries, evidence has accumulated that only about 10% of school achievement can be attributed to schools and teachers while the remaining 90% is due to characteristics associated with students. Teachers account for from 1% to 7% of total variance at every level of education. For students, intelligence accounts for much of the 90% of variance associated with learning gains. This evidence is reviewed.

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Ageing Body, Ageing Mind: Do Cognitive and Physical Functions change together in Old Age?

Stuart J. Ritchie
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Abstract

Does the mind age at the same pace as the body? Previous studies have observed coupled changes in physical and cognitive functions, leading to the 'common cause' hypothesis of aging: the suggestion that a single underlying process is responsible for much of the variance in both cognitive and physical decline in ageing. We tested this hypothesis using data from the Lothian Birth Cohort 1936 (initial n = 1,091), a well-characterized longitudinal sample with repeated measurements of cognitive functions (multiple intelligence subtests and cognitive speed tests) and physical functions (grip strength, forced expiratory volume, and walking speed) at ages 70, 73, and 76 years. Using latent growth curve modeling, we found compelling evidence that cognitive processing speed—even when it is measured without a motor component—declined alongside physical speed. However, there was little evidence to suggest that general intelligence had shared decline with any of the three physical functions (which themselves did not all decline together). This pattern of findings is mostly at odds with the 'common cause' hypothesis, and suggests a more complex picture of shared and non-shared processes responsible for the ageing of the mind and of the body.

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Advances in the Genetics of Intelligence

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Abstract

Intelligence is one of the most highly investigated traits in psychology and also one of the most heritable traits in humans. Heritability estimates range from 40% in childhood up to 80% in adulthood. Despite these high estimates of heritability, the actual genes have remained elusive. Recent large-scale genome-wide association studies have shown that intelligence is highly polygenic and influenced by many genetic variants each of small effect. Suggestive evidence for some of these genetic variants has recently surfaced. In addition, gene-based and gene-set analyses have evaluated the joint effect of multiple genetic variants and have implicated several functional sets of genes in intelligence. Lastly, proxy-phenotype analysis, using education attainment as a proxy for intelligence, has yielded novel insights into the putative genetic pathways underlying intelligence.

This presentation will review the latest evidence for genetic factors in intelligence and will provide a look into future strategies for understanding the genetic basis of this trait.

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Friday, 8th April

Advances in the Neuroscience of Intelligence

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Abstract

The theoretical definition of intelligence and the explanation of its neurobiological basis are among the most intriguing yet controversial issues in modern psychology and neuroscience. Several studies have shown that brain global and local volumes, its structural wiring as well as the magnitude of local metabolism might explain a consistent portion of interindividual variability in intellectual performance, as well as genetic-molecular factors behind its heritability. Although brain functioning has traditionally been studied in response to controlled stimuli –therefore modeling resting-state activity as stochastic noise—the last two decades of neuroimaging research have shown how spontaneous brain activity is far from random but organized in space and time at the level of micro- and macro-circuitries. Several resting-state networks have been identified, resembling the coordinated activity of brain regions responsible for low (visual, motor, somatosensory, auditory) and high level (executive functions) brain activity, making the analysis of the "human connectome" one of the most promising fields of modern neuroscience and an elective context for intelligence research. Insights from molecular biology, social sciences, physics and biochemistry are all conveying a message supporting the notion of the human brain being –and behaving like— a complex network as the keypoint to push the next decade of research in the right direction. The present talk will cover milestone studies about the neuroscience of intelligence as well as a few hypotheses about how "connectomics" might help the understanding of higher-order cognition and even pushing it beyond its limits.

Fluid Intelligence and (de)Synchronization of Oscillatory Bands in Brain

Adam Chuderski
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Abstract

Existing research on the neurocognitive mechanisms of fluid intelligence (abstract reasoning ability) follows two primary lines: One line aims at the identification of hypothetical cognitive processes that are most strongly correlated with intelligence, with memory storage capacity, attention control, and rapid learning being the three most likely candidates, whereas the other line is concerned with brain-level correlates of intelligence, like neural efficiency, reliability, and connectivity. Recently, several studies have attempted to integrate these two lines of research, by proposing and testing the formal models of abstract reasoning, implemented as dynamic oscillatory neural systems that predict the observed individual differences in intelligence test performance. These models aim to explain how the human brain ability to control the task-relevant synchronization and desynchronization of theta, alpha, beta, and gamma bands determines the success on fluid intelligence tests. The dynamic oscillatory approach is supported by the connectome modeling and by the work on large-scale brain architectures, like Spaun. This approach provides also an intriguing account of the interplay between capacity and control, showing why and when both of them are necessary for the effective abstract reasoning to occur. Although, so far, the work on the oscillatory mechanisms of fluid intelligence, which will be reviewed in this paper, yields more questions than answers, it may lead to a fruitful explanation of the purpose and features of human cognitive processes that are crucial to fluid intelligence level, as well as it may yield a plausible model of their brain implementation.

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Making Brains run Faster: Are they Becoming Smarter?

Norbert Jaušovec
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Slovenia

Abstract

The aim of the presentation is to answer the question: Can intelligence be increased by changing brain activity? An overview of approaches aiming at increasing intelligence will be discussed: (1) behavioral training, (2) neurofeedback, (3) nutrition, and (4) brain stimulation techniques like TMS, tDCS, tACS, and tRNS. Three studies will be presented in detail: (1) An origami-training approach that aimed at increasing spatial ability in women. The training changed the females' brain activity, making it similar to activation patterns of males who scored high on a Paper Folding and Cutting test (PF&C). (2) A tACS study in which theta frequency stimulation of parietal brain areas increased performance on RAPM tests, and changed the respondents' brain activation patterns. (3) A series of correlational studies investigating the controversial relation between individual alpha peak frequency (IAF) and intelligence: (a) In a large scale study (n = 417), no correlation between IAF and IQ was observed. However, significant correlations for males between the *rotation-verbal cognitive dimension* and IAF was observed. (b) Further, IAF obtained during task performance showed significant positive correlations with a measure of focus of attention (total sample), and a negative correlation with reaction time for females; whereas IAF obtained in resting (eyes closed) conditions showed no significant correlations with memory span measures. (c) In 17 subjects, tACS increased subjects' IAF. After tACS, males showed decreased RAPM performance whereas females showed increased performance. The results are discussed in the light of gender differences in brain structure and activity.

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Discussion

Roberto Colom

Universidad Autónoma de Madrid

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